Livius, C.B.

A letter addressed to canal proprietors on the practicability of employing steam power on canals.

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A

LETTER

ADDRESSED TO

CANAL PROPRIETORS

ON THE PRACTICABILITY OF EMPLOYING

STEAM POWER ON CANALS.

BY

CAPT^N. BARHAM LIVIUS.

LONDON:

J. HATCHARD & SON, 187, PICCADILLY;

AND

SMITH, ELDER, & Co. CORNHILL.

1842.

PRINTED BY GEO. WITT,
EARL'S COURT, SOHO.

GENTLEMEN,

The deep interest which attaches itself, at this moment, to all questions relating to the prosperity of our inland navigation, and the importance of the facts which form the subject of the present communication, will, I trust, be considered as a sufficient apology for soliciting your attention to the following pages.

The numerous attempts that have been made to overcome the difficulties which oppose themselves to the employment of steam as a propelling power, in canal navigation, have hitherto proved so unavailing, that I should scarcely have ventured to express the conviction which I entertain, that this most desirable object has been at length accomplished, had I not found myself supported in that opinion by two professional gentlemen, of acknowledged talent and experience, whose report on the subject I have subjoined.

Under the sanction of authority so unquestionable, I no longer feel any difficulty in asserting, that the obstacles which have hitherto impeded the employment of steam power on canals have been removed, and that its substitution for that of horses can now be effected with advantage to all parties connected with inland navigation.

If I succeed in establishing this proposition, no doubt can, I conceive, be entertained of your cordial support of a measure, the effect of which will be so largely to improve the value of your property, and which must be beneficially felt in almost every branch of our productive industry.

The difficulties which have hitherto opposed themselves to the employment of steam power on canals it is well known are—

1st.—The want of an apparatus capable of propelling, in *shallow* and *confined water*, a heavily-laden flat-bottomed boat, at a *profitable rate* of speed, without occasioning a surge destructive to the banks.

2nd.—The want of a boiler, adequate to the purpose required, and yet not too bulky for boats of the limited dimensions and draught of water, required for canal navigation.

3rd.—The necessity for employing a greater power to propel a vessel in narrow and shallow water, than is required to obtain the same velocity in deep rivers, or the sea.*

And lastly—The difficulty of devising means to compensate for the loss of room, occupied by the necessary machinery and fuel, no augmentation in the depth or width of the boats being admissible, in consequence of the shallowness

* This difficulty has a reference more especially to vessels moving at velocities under seven or eight miles an hour.

and narrowness of the canals, while the limited dimensions of the locks necessarily preclude the possibility of their admitting boats of greater length than those at present in use.

The discovery of means whereby these various difficulties can be overcome, has been accomplished by Mr Redmund, of the Wellington foundry, Charles-street, City-road, an engineer, who, for a series of years, has devoted all the energies of his mind to this object, and has expended a large capital in perfecting his inventions.*

It is by the combination of three distinct inventions or improvements, for each of which (as well as of various others connected with them) patents have been secured, that Mr. Redmund has succeeded in accomplishing his object. They consist of—

1st —A PROPELLER (or paddle wheel) upon an entirely new principle, which causes neither wave nor surge.

2nd.—A BOILER, peculiarly calculated for canal navigation, by its remarkable power, perfect safety, and compactness.

And 3rd.—An iron boat, so constructed, as fully to compensate for the space occupied by the machinery and fuel.

* Mr. Redmund, having for the last twenty years laboured under the serious misfortune of deafness, has been unable to enjoy that intercourse with the scientific world, or to take that position in his profession to which his abilities so justly entitle him,—a circumstance which has induced the writer to devote his attention to the details of inventions, which appear to him of national importance.

The following extract from the report made by an eminent civil engineer, who has been consulted on the subject, affords satisfactory testimony as to the merits and practicability of the above inventions :—

"I have examined Mr. Redmund's patent iron steam boat, boiler, and propeller, and witnessed their performance on the Regent's canal, for the purpose of reporting my opinion on their practical adaptation to canal and river navigation.

"In this investigation I have been assisted by Mr. John Barnes, an Engineer of pre-eminent mechanical ability and experience in constructing engines for steam navigation, and the result of our joint opinion upon Mr. Redmund's invention is, that the iron boat with its moveable ends possesses the qualities of great strength, buoyancy, roomy stowage, and easy means of steerage.

"That the boiler is a masterly contrivance, embracing great strength and security under a very high pressure, and is exceedingly compact.

"That the paddle wheel or propeller, placed in an iron case within the boat's width, is of very peculiar construction, and in its operation creates no surge, while it gives a buoyancy to the boat, which materially facilitates its passage over shoals.

"The above boat and propeller will not only

carry its own load of passengers and goods, but forms at the same time a tug to one or more stowage boats in its train, either of the patent model, or of those at present in use.

"Its character in fact promises such beneficial results on inland navigation, that Mr. Barnes and myself deem it worthy of particular verification, as we are persuaded that Mr. Redmund's calculations will be thereby realized."

"FRANCIS GILES,"
"Civil Engineer."

"11, *Beaufort Buildings.*"

As some further description of inventions, which come so highly recommended, may be desirable, I proceed to state the following particulars:—

The PROPELLER (a view of which will be found in the accompanying plate) is fixed within, towards the stern of the boat, and is contained in an air-tight iron case.*

The action of the paddles, as they descend in succession beneath the case, is analogous to that of the feet of an aquatic bird in swimming, and *adds to the buoyancy of the boat.* Having passed through the water, their ascent into the case is effected in a vertical position, and passing round edgeways within the case, all friction or resistance from the water is avoided.

* The case may be kept either entirely or only partially filled with water; in the former case, no vibration whatever results from the action of the propeller.

The two most remarkable and valuable properties in the propeller, which render it peculiarly available for canal navigation, are, that its *action is unattended by the slightest ripple moving in the direction of the banks of the canal,* and its operation tends to *diminish the draught of water of the boat.*

The BOILER, described by Messrs. Giles and Barnes as "a masterly invention," is on a plan altogether different from any at present in use, and combines every requisite quality for canal steam navigation.

The water is contained in a number of separate chambers, constructed of corrugated sheet iron, of an adequate strength, and secured by stout iron plates, bolts, and links, the latter never being heated. The water in each chamber being thus subdivided (as will be seen by inspecting the accompanying plate) into a number of triangular columns, formed by their fluted sides, and being by this means exposed to a greatly extended action of the heat, steam is rapidly and abundantly generated, the most perfect safety ensured, and a considerably less consumption of fuel required, than for any other boiler of equal power.

The BOAT is constructed of sheet iron, of sufficient strength, riveted and secured to the internal ribs or framing, by methods for which, as well as for the ribs, patents have been

secured: an extraordinary accession of strength and solidity is thereby obtained, and the sides of the boat are rendered capable of resisting any shock to which they may be liable.

The dimensions of the boat are,—length, 90 feet; width, 7 feet; and depth, 3 feet 9 inches. It will, therefore, be observed, that it is 20 feet longer than the boats at present in use, and consequently would be incapable of entering the canal locks, which rarely exceed 70 feet in extent, were it not for a very ingenious contrivance, by means of which the boat can be reduced to the required length.

A boat upon this principle, drawn by horses, has been for some time employed in Ireland, for the conveyance of passengers, and is thus described in the "Transactions of the Institution of Civil Engineers":—

"The attention of Mr. Williams having been attracted to the successful plan for the conveyance of passengers adopted on the Glasgow and Paisley Canal, where light sheet-iron boats of great length travel at a speed of nine miles an hour, he was induced to attempt the introduction of the same system on the Irish canals. A great difficulty, however, presented itself, as the locks there would only admit boats 60 feet long, which length was quite inadequate to the carrying out with advantage the principle involved in the long light Scotch boat. To overcome

this difficulty, he constructed a sheet-iron boat, 80 feet long and 6 feet 6 inches wide at midships, having the stem and stern ends (each 10 feet long) attached by strong hinges to the body, and susceptible of being rapidly raised to a vertical position by means of winches; thus reducing the length to 60 feet when required to pass through a lock. It is evident that by this means there would be gained not merely the apparent additional buoyancy of 10 feet at each end of the boat, which from the form would not be very effective, *but in reality the buoyancy due to an addition of* 20 *feet of the midship section.*

"The boat thus constructed has been found to answer perfectly; the buoyancy is equal to that of the Scotch boats of similar dimensions; no crankness or unsteadiness accrues when the ends are raised; it is capable of carrying sixty passengers, travelling at a speed of nine miles per hour, *with the same power that was required to draw a* 60 *feet boat with a less load,* and there is a much less action on the canal bank in consequence of the increased length, which at the same time imparts stiffness, and enables passengers to enter and leave the boat with safety. Considerable time is saved in passing the locks, by the opposition of the square end when the bow is raised; the boat may thus be run almost at full speed into the lock, and both ends being raised simultaneously, *it is stopped*

much more easily than if the tapered ends were down. No provision is necessary for keeping the ends down, as the weight of the bow and steersman answers the purpose.

"This boat has been working without intermission for three years between Limerick and Killaloe, traversing twice daily a distance of fifteen miles, on a navigation of considerable intricacy, and passing eleven locks, without any accident having hitherto occurred.

"Independent of the advantages of carrying more passengers, by continuing the midship section to the length of 60 feet, *considerable speed was gained* by the 80 feet boat, in consequence of its fine entrance and run.

"So great is the facility in managing the ends, that on quitting a lock the bow end is lowered as the gates are opening; the boat is set in motion at the same time, and as it moves on, the stern end is let down, and the usual speed is obtained very soon after it clears the lock. When the lock is to be entered, the boat is suffered nearly to reach the gate at full speed, when the bow end being raised, the additional resistance caused by the square section being suddenly opposed to the water *stops the boat almost immediately*."

Mr. Redmund's patent boat includes several improvements and advantages, which are not to be found in the Irish boat; of which one of

great importance is, the facility of moving the ends in a *horizontal* as well as in a perpendicular direction, whereby the sudden and acute bends which exist on some of the English canals, can be turned with greater facility, and the danger of collision on either meeting or passing other boats is avoided.

Having thus described the most remarkable features in Mr. Redmund's inventions and improvements, I proceed to state the advantages which they offer, both in point of *speed and of economy* over the present system by trackage.

In order to establish a fair comparison, that portion of the Grand Junction and Birmingham Canals, which extends from London to Wolverhampton, has been selected; and in this choice Mr. Redmund has evidently not been influenced by any peculiar facilities which that line offers, since it includes no less than 130 locks, and the average depth of the water scarcely exceeds 4½ feet.

The fly boats at present in use carry 15 tons, and employ rather more than seven days and nights, including loading and unloading, and all delays, to perform the voyage from London to Wolverhampton and back again, being a distance of 326 miles, the average expense of the trip (as appears by the statement, page 21) being £14. 6s. 10½d.

The average expence incurred by the carriers

for conveying 15 tons of goods 326 miles is, therefore, 19s. 1½d. per ton, or 70-100ths of a penny per ton per mile.

Two journeys from London to Wolverhampton and back, or 652 miles, can be accomplished, including all delays, within the seven days (see statement, page 21,) by one of Mr. Redmund's steam boats, carrying 12½ tons of goods, (besides the machinery,) and having in tow another iron boat of the same description and dimensions, containing 20 tons, and at a cost of about £25. 10s. (see page 22.)

The cost of conveying 32½ tons of goods 326 miles by the proposed plan, is consequently 7s. 10d. per ton, instead of 19s. 1½d. per ton, or 28-100ths of a penny, instead of 70-100ths of a penny per ton per mile.

The saving of expence effected by each pair of boats per week, as compared with the present cost of the fly boats, would therefore be as follows:—

Cost of conveying by the present fly boats 32½ tons of goods 652 miles, at the rate of 70-100ths of a penny per ton per mile . . .	£62	3	7
Cost of conveying by the proposed mode 32½ tons of goods the same distance	£25	10	0
Balance, being the net saving in seven days	£36	13	7

The advantages of the proposed mode of canal conveyance will be found even greater, if contrasted with the costs of the present slow boats, which move only by day, and are employed for the heavier description of wares, and in cases where cheapness is more important than speed.

The boats of this description at present in use carry on an average 22 tons, and proceed by day only, at a rate of about two miles per hour, accomplishing the journey from London to Wolverhampton and back in about 15 days, at an average cost to the owners of £16. 10s.

The cost, therefore, of conveying 22 tons of goods 326 miles is 15s. per ton, being at the rate of 55-100ths of a penny per ton per mile.

Now one of the proposed steam boats towing *two* patent luggage boats (instead of one as in the former case), the steam boat carrying 24 tons of luggage, and each of the luggage boats 32 tons, together 88 tons, (but nevertheless drawing less water than the present slow boats), would accomplish the journey to Wolverhampton and back, or 326 miles, moving only by day, at the rate of $3\frac{1}{2}$ miles an hour, in about $8\frac{1}{2}$ days (see page 22), being, as in the former case, about half the time occupied by the present boats, and at an expence (see page 23) of £19.2s.

The rate of expence of conveying 22 tons of goods 326 miles, on the proposed plan, would

therefore be about 4s. 4d. per ton, instead of 15s., or 16-100ths, instead of 55-100ths of a penny per ton per mile, *being a saving of above 2-3rds of the present expense.*

The following statement will present the saving in 8½ days, by Mr. Redmund's plan:—

Cost of conveying by the present slow boats 88 tons of goods 326 miles, at the rate of 55-100ths of a penny per ton per mile . . .	£65 14 10
Cost of conveying the same quantity of goods the same distance by the proposed plan, at the rate of 16-100ths of a penny per ton per mile	£19 2 0
Balance, being the net saving in 8½ days	£46 12 10

From the preceding statement of expences, it is apparent that the superiority of the proposed system over the present, is, in the case of the *fast boats,* as £25. 10s. to £62. 3s. 7d., and in that of the *slow boats,* as £19. 2s. to £65. 14s. 10d., and that in point of time, the advantage gained is nearly double in both cases.*

* In the foregoing statements, no calculation has been made with reference to the outgoings for the establishments on either side, nor has the question of interest of capital invested been touched on, it being extremely difficult to ascertain with any degree of precision their comparative amount; when, however, the expense of the horses employed and their requisite attendants, and the losses to which that description of property subject their owners, are taken into consideration, it will appear that the deduction to be made from the above balance on that account would be inconsiderable, especially as it will be seen that a charge has been made in the calculations for "wear and tear" of the steam boats, but none for that of the boats at present employed.

As it might be supposed that the adoption of the proposed improvements would involve the suppression of the boats at present in use, and consequently be a source of serious injury to the interests of the carriers, the subjoined calculations have been added, in order to prove that this supposition is not founded in fact; since it appears thereby, that a considerable saving, both in expense and in time, would arise from the adoption of the proposed steam boat *as a tug to tow the present boats* instead of horses.

The steam boat, if employed as a tug for the present *fly boats*, would carry 14½ tons of goods, and take one of those boats in tow, loaded with 18 tons—together 32½ tons; and being propelled at the rate of 4½ miles per hour, the distance from London to Wolverhampton, and back (326 miles), including all delays, would be accomplished in four days, and at a cost of £14. 12s. 6d., or 9s. per ton for 326 miles, (see page 23.)

The saving effected in eight days, by employing the steam boat in lieu of horses, would consequently be as follows:—

Cost at present of conveying 32½ tons 652 miles by the fly boats, at the rate of 19s. 1½d. per ton for 326 miles	£62 3 7

Cost of conveying the same quantity the same distance, employing the steam boat as a tug to the present fly boats, at the rate of 9s. per ton for 326 miles . .	£29	5	0
Saving in 8 days with one boat .	£32	18	7

If employed to tug the *slow boats* at present in use, the steam boat would carry 24 tons, and take in tow two of those boats, each loaded with 22 tons—together 68 tons; they would be propelled at the rate of three miles per hour, and the journey to Wolverhampton and back, including all stoppages, in 10 days, at a cost of £21. 7s., about 6s. 3¼d. per ton for 326 miles, (see page 24.)

On comparing this cost with the present expense, we obtain the following result as the saving in 10 days:—

Cost at present of conveying 68 tons of goods 326 miles by the slow boats, at the rate of 15s. per ton for 326 miles	£51	0	0
Cost of conveying the same quantity the same distance, using the steam boat as a tug for the present boats	£21	7	0
Difference in 10 days in favor of the proposed plan* . . .	£29	13	0

* See note, page 15.

The preceding statements are founded on a series of experiments made on the Regent's canal with a full-sized iron boat, fitted-up with Mr. Redmund's boiler and propeller. Practical demonstration of their power and properties has thus been afforded, which leave no room to doubt of their efficiency and capabilities.*

As respects the application of Mr Redmund's inventions to *light boats*, for the conveyance of passengers, although no opportunity has hitherto been afforded for testing the precise rate of speed attainable by their means, with boats of this description; yet, from the proofs of their power and efficiency, in the case of heavy boats, there can be no doubt that great advantages will result from their adoption for this purpose.

Mr. Redmund has succeeded in *doubling the rate of speed* at present attained by horses, in the case of the heavy luggage boats now in use, which weigh about 28 tons, and draw about 27 inches of water;—if, therefore, the same means be employed to propel boats built for *rapid movement*, (which, constructed on his plan, including the machinery and cargo, would not weigh above 14 tons, nor draw more than 17 inches of water) the conclusion appears to be warranted, that a rate of speed, fully equal to, if

* This boat did not possess the advantages of the jointed ends, and its weight and draught of water were nearly double that of the patent boats.

not greater than that which has hitherto been attained by boats of this description tracked by horses, and certainly at a *much less cost*, might with confidence be calculated upon; especially when the great power of Mr. Redmund's boiler, the peculiar construction and properties of his propeller, the advantages of the fine lines, and superior build of his patent boat, are taken into consideration.

I need not enlarge upon the advantages which must arise to canal property from the adoption of a cheaper and speedier conveyance of goods and passengers, as they are too obvious and indisputable to require being pointed out. I cannot, however, dismiss this point, without remarking that the employment of the proposed boats, in consequence of their extended capacity for cargo, will effect the saving of about a third of the water in lockage, and do away with the expense of keeping up towing paths, which, being no longer necessary, would become available for wharfs, or other purposes.

The prospect which the new system holds out to the carriers of goods, is no less encouraging than that which it presents to yourselves; for being thereby enabled to lower the rates of freight, and to deliver their cargoes in about half the present time of transit, the restoration of a considerable portion of the traffic, which, it is well known, has latterly been trans-

ferred into another channel, might, with certainty, be calculated upon.

It has been already shewn that the establishment of the proposed plan would by no means (as some persons have apprehended) necessarily occasion the suppression of the boats at present in use, since the steam boat is capable of being employed *with great advantage*, conjointly with them, as a tug, instead of horses.

To the iron-master, the coal proprietor, the merchant, and the manufacturer (especially of hardware), the present question is one of still deeper interest, since it involves the increased consumption, which must be the natural consequence of an increased facility of supplying the public at a cheaper rate—an advantage in which the community at large will participate.

Having thus, I trust, made it apparent, that the adoption of the proposed system of canal steam navigation is not only practicable, but calculated to insure important advantages to all parties connected therewith, as well as to the public, I terminate the task which I have imposed upon myself, not doubting that every possible encouragement will be held out to an undertaking, which has for its object the restoration of the prosperity of our canals; and indulging the confident hope, that the genius of invention and improvement, whose influence has been already felt throughout this country in

almost every other direction, is at length about to shed her beneficial light upon this important source of our national greatness.

I have the honor to be,
Gentlemen,
Your very obedient humble Servant,
BARHAM LIVIUS.

Nov. 1841.

CALCULATION, No. 1.

Expenses paid by four of the principal London carriers, for the conveyance of goods:—

	Per Ton. £ s. d.	Per Journey and Back. £ s. d.
Expenses incurred by Messrs. Shipton, for their day and night fly boats, carrying 15 tons of goods, for the journey from London to Wolverhampton and back, being 326 miles, and occupying (loading and unloading) seven days and nights	0 16 0	12 0 0
Ditto by Messrs. Pickford; their boats also carrying 15 tons, and performing the distance in the same time	1 0 2	15 2 6
Ditto by Messrs. Crowley, ditto ditto	1 0 2	15 2 6
Ditto by late Robins and Mills, ditto ditto	1 0 2	15 2 6
	3 16 6	57 7 6

Being an average of £14 6s. 10½d; or for each trip 19s. 1½d. per ton; or 70-100ths of a penny per ton per mile.

CALCULATION, No. 2.

Time employed by Mr. Redmund's patent canal boats, having one patent luggage boat in tow, to convey 32½ tons of goods 652 miles:—

	Hours.
326 miles (from London to Wolverhampton and back) at 5½ miles per hour	59¼
Loading and unloading, and stoppages at locks, found to be on an average about	23
Total time for one journey to and from	82¼
Two journeys and back, being accomplished within the week, total time employed	164½

CALCULATION, No. 3.

Expense of conveying 32½ tons of goods 652 miles (being one week's work) by Mr. Redmund's engine boat, having a patent luggage boat in tow:—

	£	s.	d.
Wages to one engineer and stoker for seven days	2	10	0
Ditto seven nights	2	0	0
Ditto two steersmen to each boat, at 24s.	4	16	0
Ditto two boys to each boat, at 6s.	1	4	0
Coke, 180 sacks, for 140 hours, at 1s.	9	0	0
Oil, Tallow, &c.	2	0	0
Wear & tear, being 10 per cent. on cost of boat & machinery	4	0	0
	£25	10	0

Being £7. 10s. per ton for each trip, or 28-100ths of a penny per ton per mile.

CALCULATION, No. 4.

	Per Journey and Back.
The cost of the slow day boats employed by Messrs. Crowley, and most of the principal carriers in London, is an average of	£16 10 0

They require the service in general of one horse, one man, and one boy, to accomplish the journey out and home in about 15 days, and carry on an average 22 tons.

The expense per ton for the whole journey is, therefore, 15s. per ton; or above 55-100ths of a penny per ton per mile.

CALCULATION, No. 5.

	Tons.
The steam boat to carry	24
First luggage boat	32
Second ditto ditto	32
Total tonnage (exclusive of steam machinery)	88

Being equal to ⅓ more in each than the present slow boats carry.

CALCULATION, No. 6.

Time employed by the engine boat, towing two luggage boats, proceeding only by day, and accomplishing the journey to Wolverhampton and back in 8½ days:—

	Hours.
Working each day	14½
Resting at night	9½
Total	24
Thus being in 8½ days—	
In motion	93
Allowing for loading and unloading, locks, and delays	30
Total working	123
Total resting	81
Total	204

CALCULATION, No. 7.

Expenses attending the journey from London to Wolverhampton and back, with an engine boat, carrying 24 tons, and tugging two luggage boats, each carrying 32 tons, together 88 tons, and accomplishing the same in 8½ days:—

	£	s.	d.
Engineer and stoker, 8½ days	2	18	0
Three steersmen and two boys	3	16	0
120 sacks of coke, used in going 93 hours	6	0	0
Oil, Tallow, and sundries, about	2	0	0
Allowed for wear and tear, and renewal as usual, 10 per cent. on £2280	4	8	0
	£19	2	0

Being 4s. 4d. per ton, or about 16-100ths of a penny per ton per mile.

CALCULATION, No. 8.

Time employed by Mr. Redmund's patent steam luggage boat, carrying 14½ tons, towing one of the present fly luggage boats, carrying 18 tons, together 32½ tons, 652 miles:—

	Hours.
326 miles (from London to Wolverhampton and back) at the rate of 4½ miles per hour	72
Loading and unloading, and stoppages at locks, found to be on an average about	23
Total time for one journey to and from	95
Time for 2nd journey, making together 652 miles, say 8 days	95
	190

CALCULATION, No. 9.

Expense of conveying 32½ tons of goods 652 miles (being 8 days' work) by Mr. Redmund's steam luggage boat, having one of the present heavier-constructed fly boats in tow:—

	£	s.	d.
Wages to one engineer and stoker for eight days	2	17	0
Ditto ditto for eight nights	2	7	0
Ditto two steersmen to each boat	5	9	0
Ditto two boys	1	8	0
Coke, 208 sacks, for 165 hours, at 1s. per sack	10	8	0
Oil, tallow, tow, &c.	2	6	0
Wear and tear, being 10 per cent. on cost of two boats	4	10	0
	£29	5	0

Being £14. 12s. 6d, or 9s. per ton for 326 miles.

CALCULATION, No. 10.

Time employed by the steam luggage boat, towing two of the present constructed slow luggage boats, proceeding only by day, and accomplishing the journey to Wolverhampton and back in 10 days:—

	Hours.
Working each day	14½
Resting at night	9½
Total	24

Thus being 10 days, as follows:—

In motion	115
Allowing for loading and unloading, locks and delays	30
Total working	145
Total resting	95
Total	240

CALCULATION, No. 11.

Expenses attending the journey from London to Wolverhampton and back, with a steam luggage boat, carrying 24 tons, and towing two of the present luggage boats, each carrying 22 tons, together 68 tons, and accomplishing the same in 10 days:—

	£	s.	d.
Engineer and stoker, 10 days	3	7	6
Three steersmen and two boys	4	9	6
149 sacks of coke, for 115 hours	7	10	0
Oil, tallow, and sundries, about	2	5	0
Allowed for wear and tear, and renewal of three boats, 10 per cent. on £1950	3	15	0
	£21	7	0

Or 6s. 3¼d. per ton for 326 miles.

G. WITT, PRINTER, 7, EARL'S COURT, LEICESTER SQUARE.